MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

EEL1016 – ENERGY CONVERSION I

(LE)

12 MARCH 2020
9:00 AM – 11:00 AM
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This examination paper consists of 3 pages with 4 Questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) State FOUR advantages of poly-phase systems over the single-phase systems. [4 marks]

(b) Figure Q1 shows the per-phase (phase-a) equivalent circuit of a balanced three-phase Y-Y connected power system. The per-phase impedances for the generator (Z_g), transmission line (Z_{Line}) and load (Z_{load}) are as shown in the figure. Assume positive phase sequence,

(i) Calculate the line currents. [4 marks]
(ii) Determine the phase voltages of the Y-connected load. [3 marks]
(iii) Find the line voltages of the load. [4 marks]
(iv) Determine the phase voltages of the generator (V_{an}, V_{bn}, V_{cn}). [4 marks]
(v) Calculate the power factor of the system. [1 marks]
(vi) Calculate the total apparent power of the load. [2 marks]
(vii) Draw the phasor diagram of the phase currents and load line voltages. [3 marks]

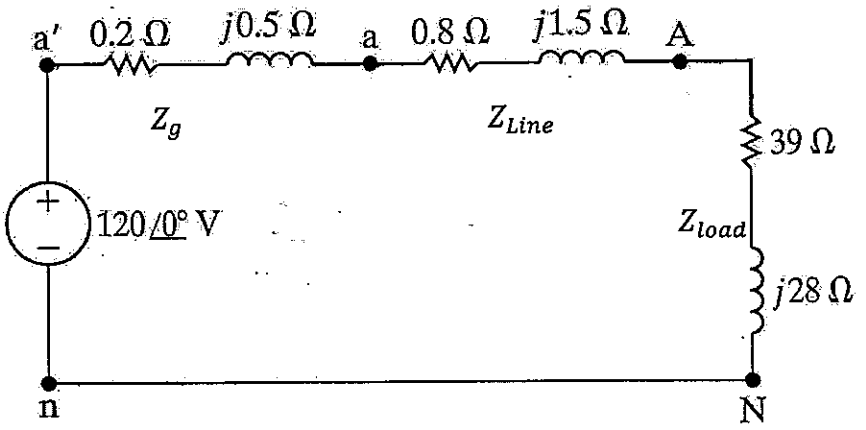

Figure Q1

Question 2

(a) The efficiency of a transformer is defined as the ratio of output power to input power, with input power = output power + losses. Briefly discussed on the losses incurred in the transformer. [5 marks]

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(b) A 10 kVA, 2500/250 V, 50Hz, single-phase transformer gave the following test results:

Open-circuit test:
250 V, 1.5 A, and 100 W measured on the *low voltage* side

Short-circuit test:
100 V, 8 A, and 320 W measured on the on *high voltage* side

(i) Compute the parameters of the equivalent circuits. [7 marks]
(ii) Draw the equivalent transformer circuit referred to the primary side. Show all the values. [8 marks]
(iii) Evaluate the efficiency of the transformer at the rated condition with 0.85 lagging power factor. [5 marks]

Question 3

(a) Slip in an induction motor can be defined as the difference between flux speed (n_s) and the rotor speed (n_m).
(i) What will happen to the induction motor if the slip is equal to unity? [4 marks]
(ii) Briefly discuss on the rotor frequency when the rotor is rotating. [4 marks]

(b) A 4-pole, 50-Hz, 3-phase induction motor running on full load develops a useful torque of 150 Nm at a rotor frequency of 2 Hz. Given that the mechanical torque lost in friction and that of core-loss is 10 Nm, Calculate the following:
(i) The shaft output power, [10 marks]
(ii) The rotor copper loss, [3 marks]
(iii) The input to the motor if the total stator loss is 880 W. [2 marks]
(iv) The efficiency of the motor. [2 marks]

Question 4

(a) Determination of equivalent circuit parameters for synchronous machines can be done through three types of tests.
(i) Name the three types of tests. [3 marks]
(ii) What are the circuit parameters to be determined from the tests? [2 marks]
(iii) Sketch and label the equivalent circuit of a synchronous generator. The circuit of field current should be included. Also, write the equation to find the terminal voltage of the synchronous generator. [7 marks]

(b) A 13.5 kV, 1600 kVA, 3-phase, star-connected alternator with armature effective resistance and synchronous reactance of 1.5 ohms and 30 ohms, respectively is supplying to a load of 1080 kW at power factor of 0.8 lagging.
(i) Calculate the per phase armature current (I_A), line current (I_A) and generated voltage (E_A). [11 marks]
(ii) Find the percentage of voltage regulation for the alternator. [2 marks]

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